

Oct. 26, 1965

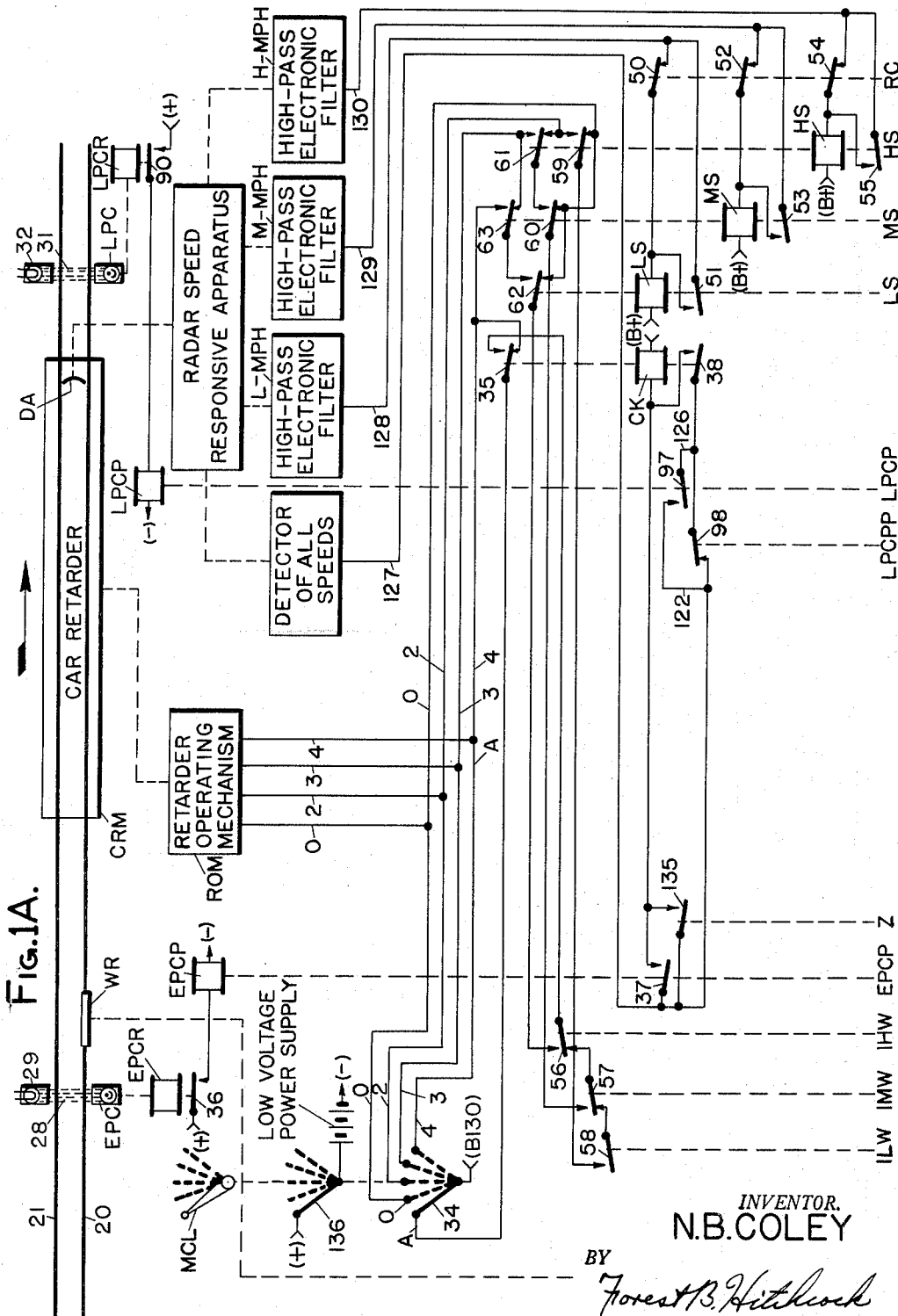
N. B. COLEY

3,214,581

CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

Original Filed June 2, 1953

9 Sheets-Sheet 1



INVENTOR.
N.B. COLEY

BY
Forest B. Hitchcock
HIS ATTORNEY

Oct. 26, 1965

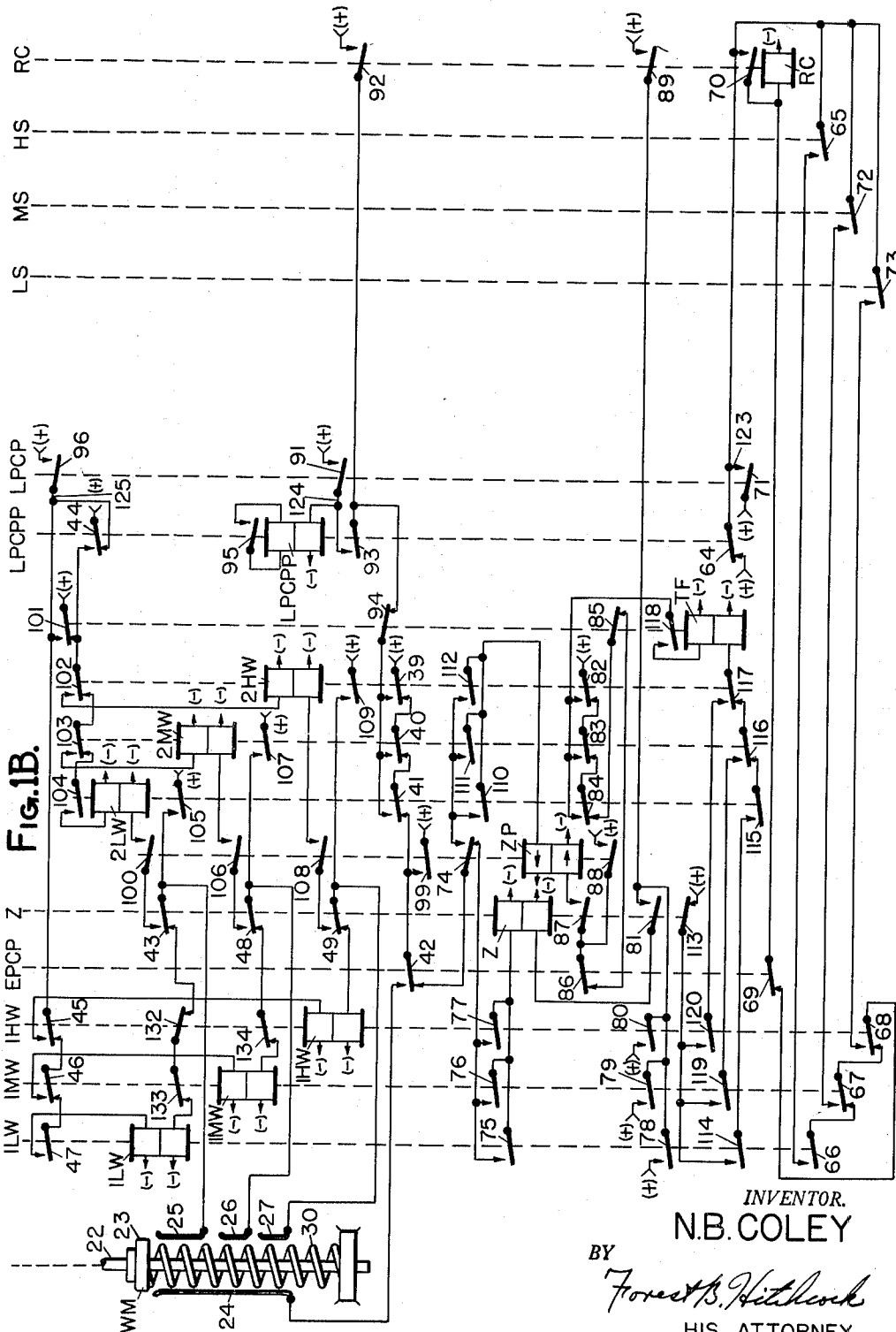
N. B. COLEY

3,214,581

CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

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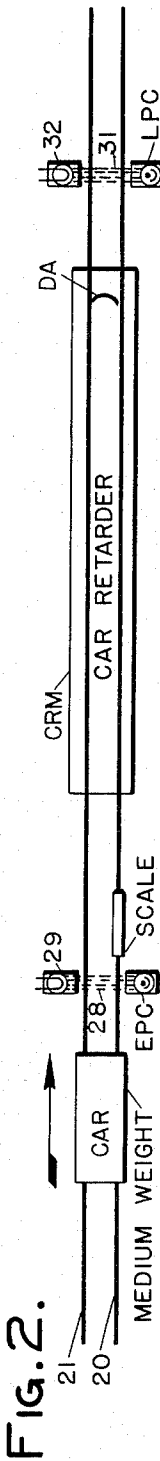
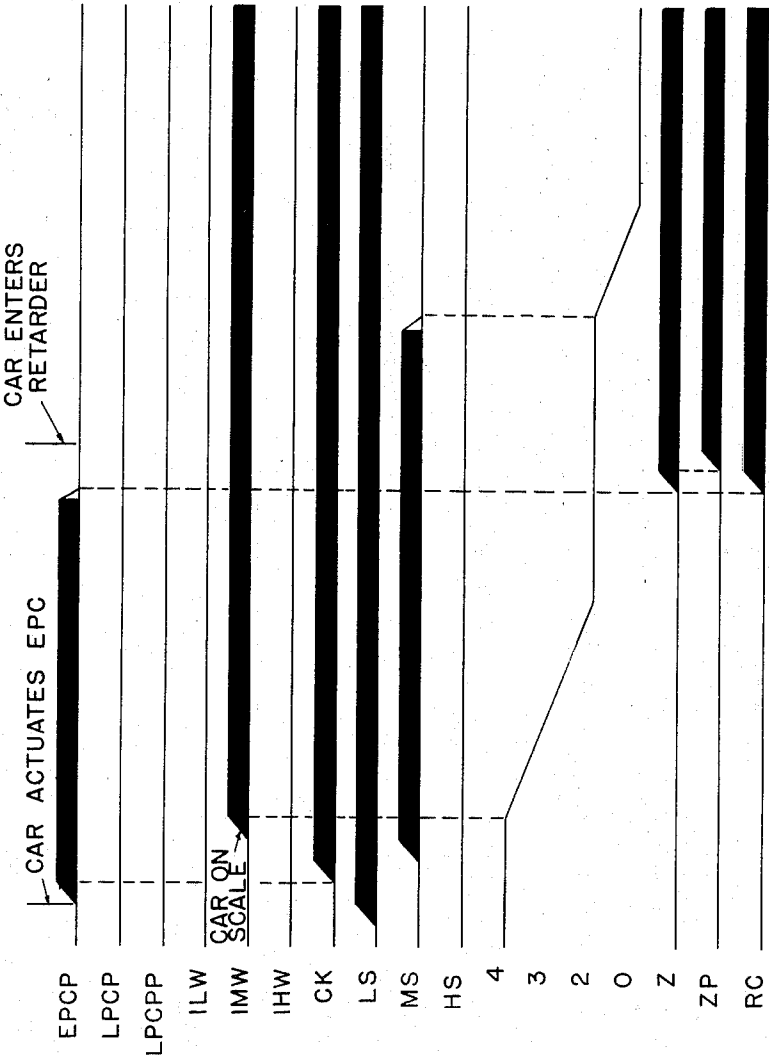
N. B. COLEY

3,214,581

CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

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INVENTOR.
N.B. COLEY
BY
Forest B. Hitchcock
HIS ATTORNEY

Oct. 26, 1965

N. B. COLEY

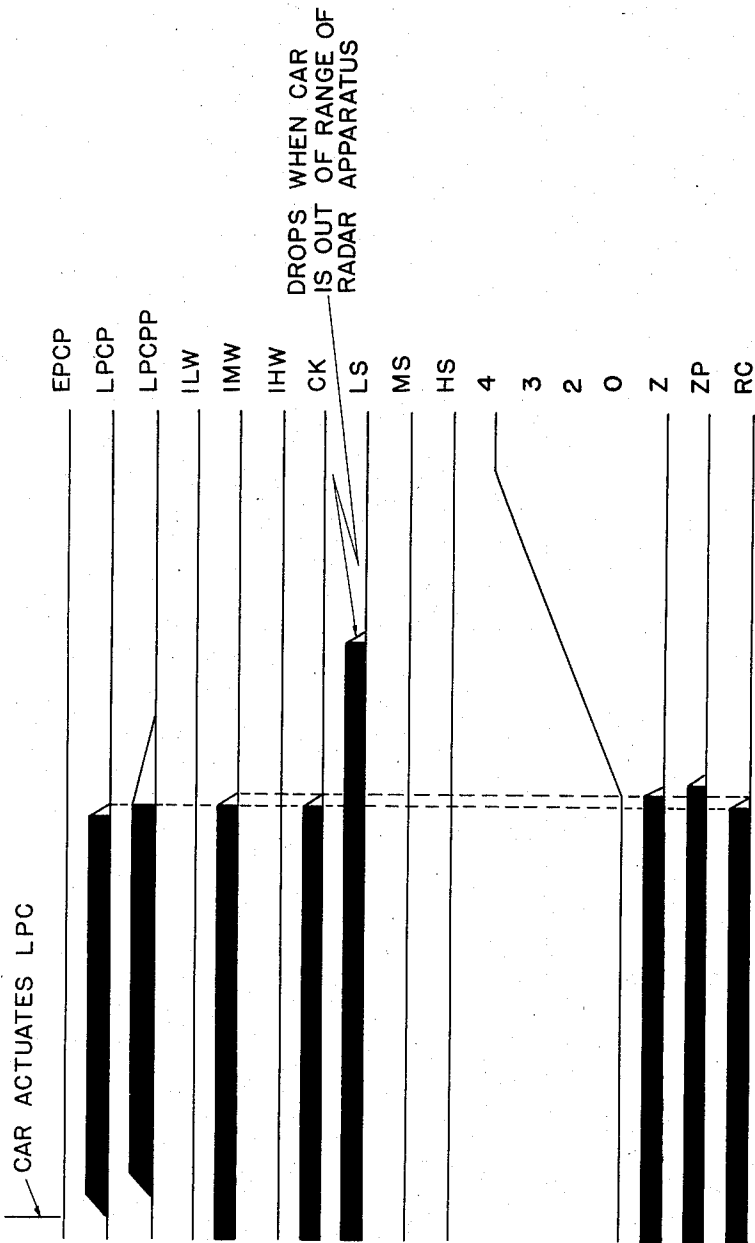
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FIG. 3B.



INVENTOR.
N.B. COLEY

BY

Forest B. Hitchcock

HIS ATTORNEY

Oct. 26, 1965

N. B. COLEY

3,214,581

CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

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Fig. 4.

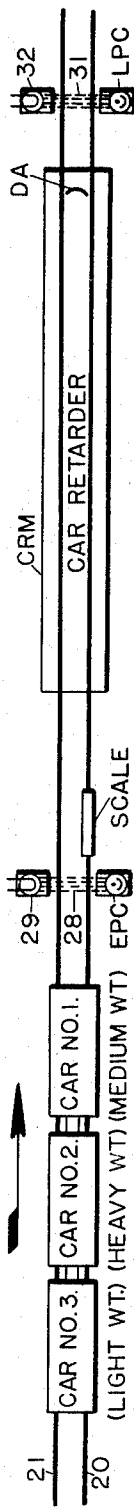
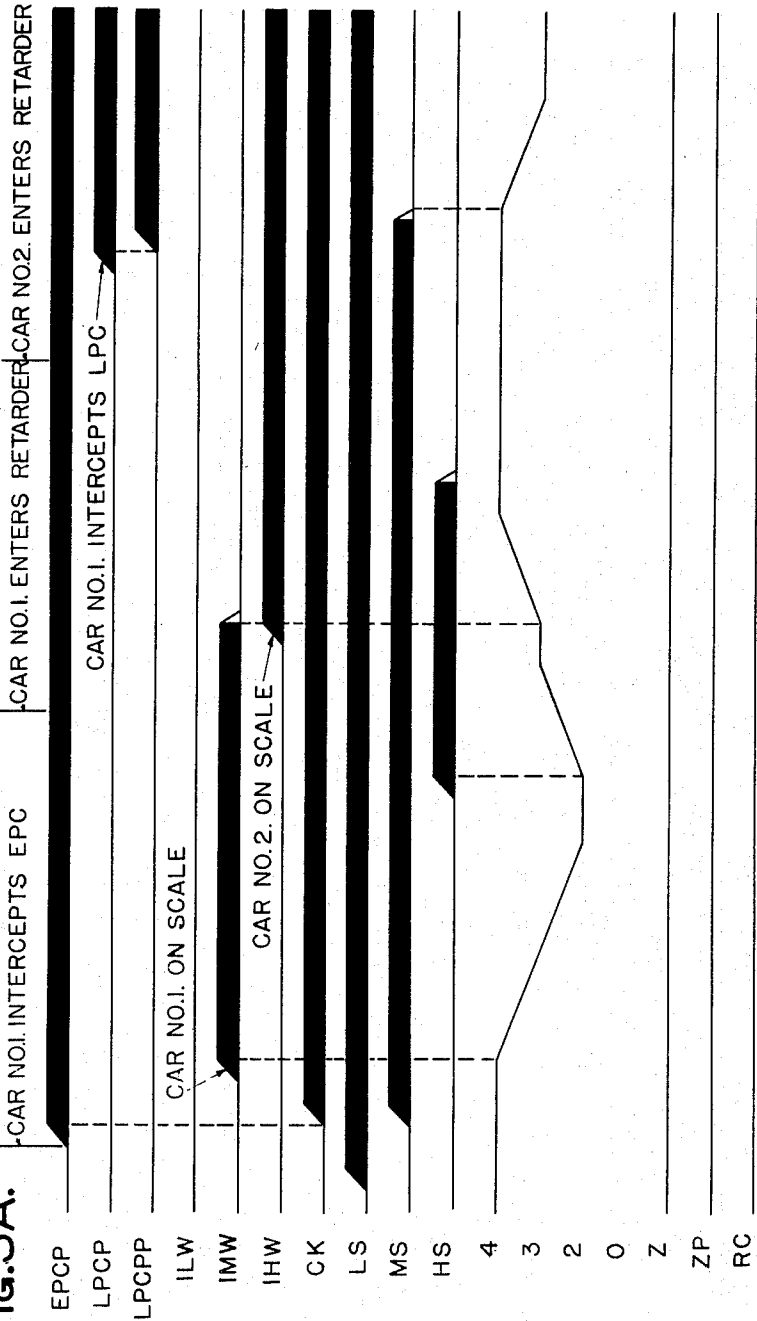


Fig. 5A.



INVENTOR.
N.B. COLEY
BY
Forest B. Hitchcock
HIS ATTORNEY

Oct. 26, 1965

N. B. COLEY

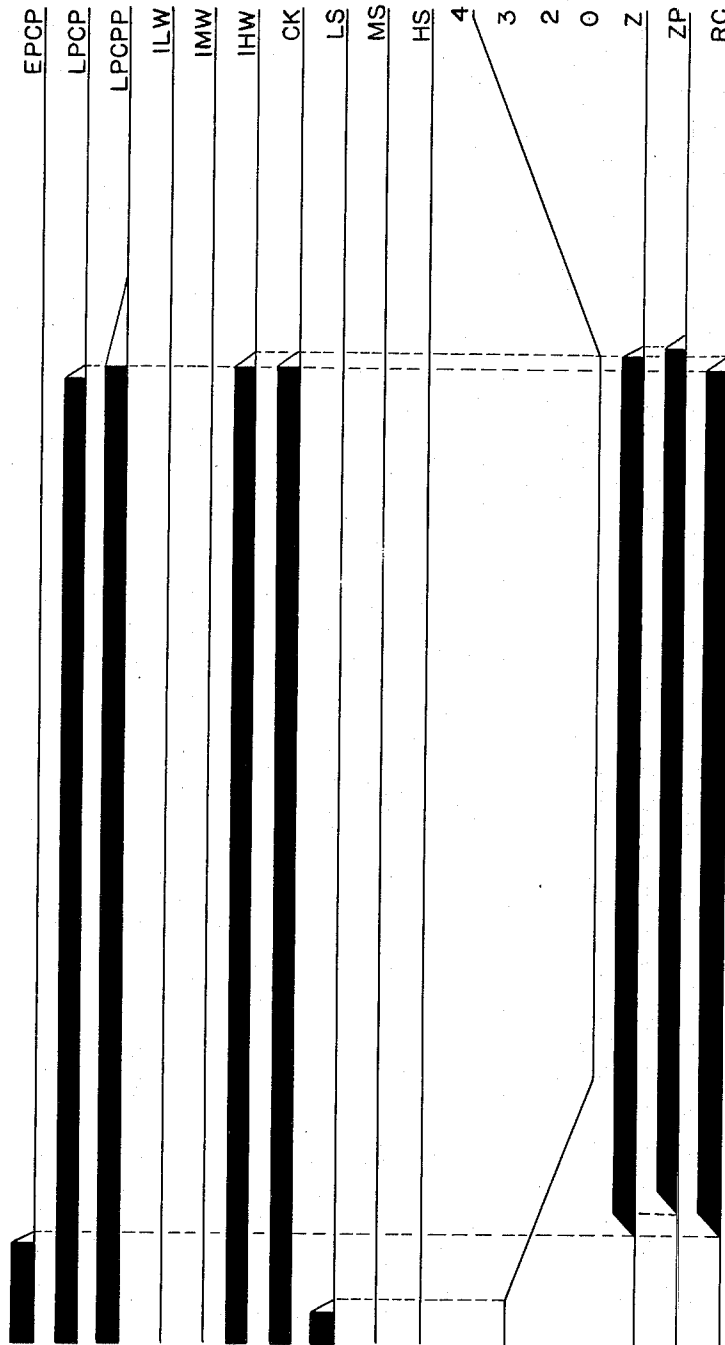
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Fig. 5B.



INVENTOR.

N.B. COLEY

BY

Forest B. Hitchcock

HIS ATTORNEY

Oct. 26, 1965

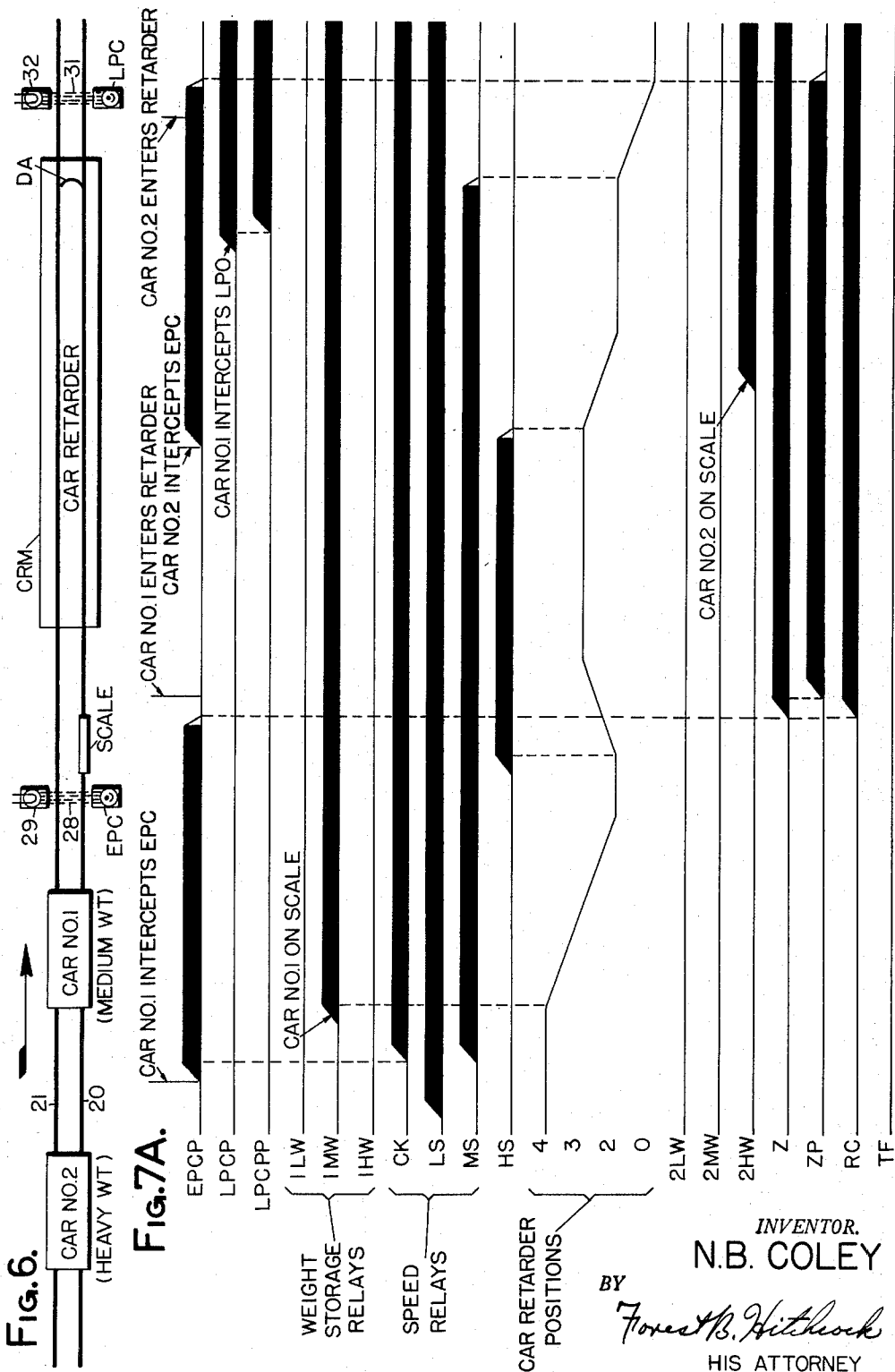
N. B. COLEY

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N. B. COLEY

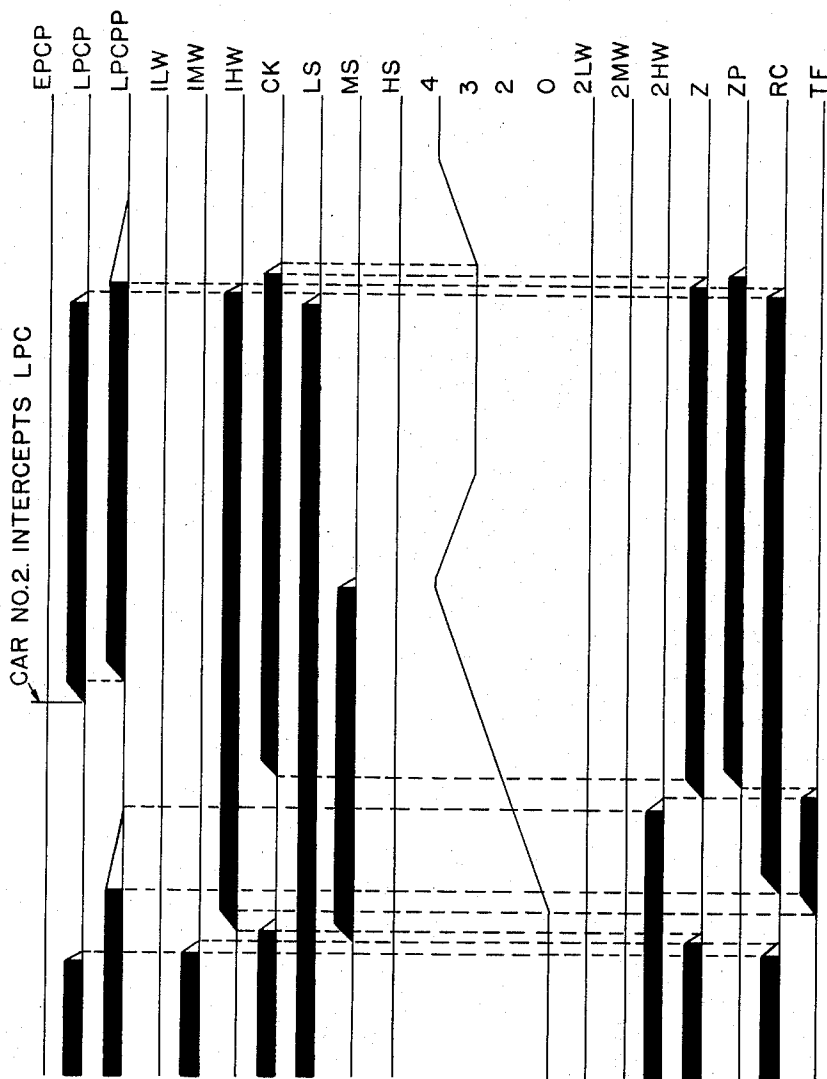
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Fig. 7B.



INVENTOR.

N.B. COLEY

BY

Forest B. Hitchcock

HIS ATTORNEY

Oct. 26, 1965

N. B. COLEY

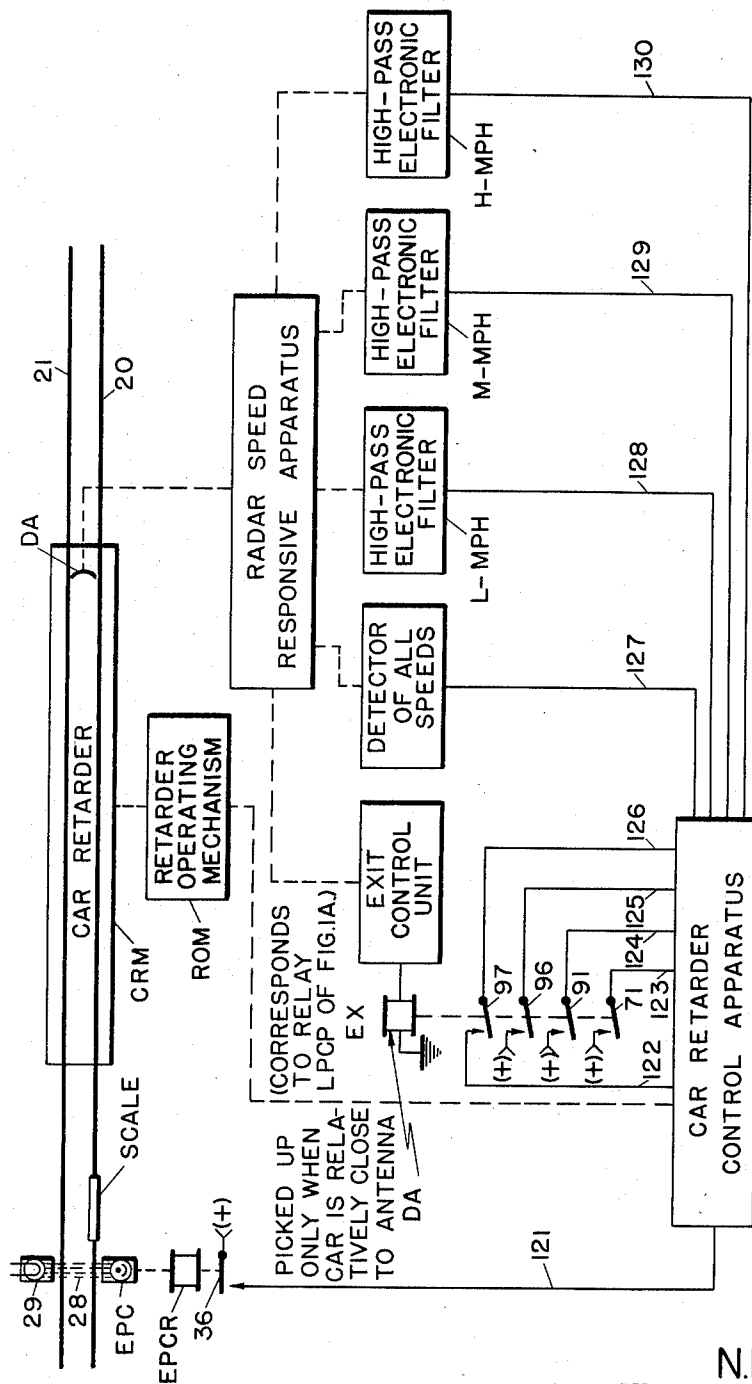
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CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

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F/G/H



INVENTOR.

N.B. COLEY

BY

Forest B. Hitchcock

HIS ATTORNEY

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3,214,581

CONTROL SYSTEM FOR RAILWAY CAR RETARDERS

Nelson B. Coley, Honeoye Falls, N.Y., assignor to General Signal Corporation, a corporation of New York
Continuation of application Ser. No. 359,069, June 2, 1953. This application July 20, 1964, Ser. No. 396,787
37 Claims. (Cl. 246—182)

This application is a continuation of my prior application Serial No. 359,069, filed June 2, 1953, now abandoned. This invention relates in general to the control of railway car retarders of the track brake type wherein the braking of a car is accomplished by applying selected degrees of pressure against the rims of the car wheels by brake shoes disposed along the trackway. The invention more particularly pertains to means for automatically governing the degree of retardation in accordance with the speed and weight of a car.

Car retarders of this character are used primarily to regulate the speed of cars in hump classification yards, where cars are respectively released at the crest of a hump and allowed to coast to respective classification tracks. In such a system, the crest of the hump must be high enough for the hardest rolling and lightest car to be classified to be able to coast to the most distant destination for such a car in the classification yard. The speeds of the cars varies materially because of different car weights, for example, and some cars are heavier or easier rolling cars than the average.

It is proposed in accordance with the present invention to automatically select the degree of retardation for each car passing through a retarder, and to release the retarder when the car has been reduced in speed to a predetermined level in accordance with its weight.

Generally speaking and without attempting to define the scope of the present invention, the retarder control system, according to the present invention, comprises radar speed responsive means near the exit end of a retarder selectively governing a bank of speed relays in accordance with the speed of a car approaching and passing through the retarder, and a weighing mechanism in approach to the retarder selectively governing a selected one of two banks of weighing relays in accordance with the weight of respective cars approaching the retarder. The retarder mechanism is automatically operated to a selected position of retardation for each car in accordance with the weight and speed of the car. The radar speed responsive means is a radio detecting and ranging apparatus wherein transmitted ultrahigh-frequency radio waves are reflected from objects they encounter, and the speed of movement of a car is detected, for example, in the form of a beat frequency formed by the mixing of the frequency transmitted and the echo received from the car which varies in frequency with the speed of the car according to what is commonly known as a "Doppler effect." Such radar speed responsive means is disclosed in the U.S. application of H. C. Kendall et al., Ser. No. 359,162, filed June 2, 1953, now U.S. Patent No. 3,125,315.

It is desirable that a heavier car following closely a lighter car (not coupled to it), for example, should not cause an increase in the degree of retardation until the light car leaves the retarder. Thus, it is provided that the weight of the second car is stored until the first car has left the retarder before this weight can influence the operation of the retarder. In order to provide this mode of operation, it is provided the exit marking means must be actuated by the first car before the weight storage for the second car can influence the operating mechanism of the retarder. Entrance marking means is also provided to permit control of the retarder only after a car has ap-

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proached within a certain limit. The entrance and exit marking means cooperate to determine when there is a car within these entrance and exist limits. If there is no car within these limits, the retarder is automatically closed to a predetermined braking position.

The entrance marking means is preferably in the form of a photoelectric device actuated by a beam of light from across the track. This beam of light is normally projected so as to be intercepted by each car and to be intercepted at coupler height so that a cut of cars (coupled together) is detected by the photoelectric device the same as if it were one long car, rather than being detected as separate cars. Under these conditions, the degree of retardation can be automatically increased immediately upon the weighing of a second car which is heavier, for example, as compared to the procedure where the heavier car is not coupled to the lighter car, and the weight of the heavier car cannot influence the operation of the retarder mechanism until the lighter car has left the retarder.

An object of the present invention is to provide improved automatic control of the degree of retardation of cars passing through a car retarder.

Another object of the present invention is to automatically set up a different system of retarder control for successive uncoupled cars passing through a retarder as compared to the system of retarder control for successive coupled cars passing through the retarder.

Another object of the present invention is to automatically control the degree of retardation of cars passing through a car retarder in accordance with the weight and speed of the cars, without requiring the use of track circuits for determining the speed of the cars.

Another object of the present invention is to bias a car retarder to a predetermined closed position in a system of the character described.

Other objects, purposes, and characteristic features of the present invention will be in part obvious from the accompanying drawings, and in part pointed out as the description of the invention progresses.

In describing the invention in detail, reference is made to the accompanying drawings in which parts having similar functions are generally identified by similar letter reference characters, and in which:

FIGS. 1A and 1B, when placed one above the other respectively, illustrate schematically the organization for one embodiment of the present invention for the automatic control of a car retarder in accordance with the weight and speed of approaching cars;

FIG. 2 is a diagram illustrating a specific traffic condition involving the passage of a single car through a car retarder;

FIGS. 3A and 3B, when placed side by side respectively, constitute a sequence chart illustrating the mode of operation of the system upon passage of a single car, such as is illustrated in FIG. 2, through a car retarder;

FIG. 4 is a diagram illustrating a specific traffic condition involving passage of a cut of cars through a retarder;

FIGS. 5A and 5B, when placed side by side respectively, constitute a sequence chart illustrating the mode of operation of the system upon passage of a cut of cars through a retarder according to the traffic condition illustrated in FIG. 4;

FIG. 6 is a diagram illustrating a specific traffic condition involving passage of two cars in close sequence, but not coupled together, through a car retarder;

FIGS. 7A and 7B, when placed side by side respectively, constitute a sequence chart illustrating the mode of operation of the system upon passage of cars through a retarder according to the traffic condition illustrated in FIG. 6; and,

FIG. 8 illustrates another embodiment of the present invention wherein the leaving detector means is governed by the radar speed responsive apparatus.

For the purpose of simplifying the illustrations and facilitating the explanation of the invention, the various parts and circuits constituting the embodiment of the invention have been shown diagrammatically and conventional illustrations have been employed, the drawings having been organized more with the purpose of facilitating the understanding of the principles and mode of operation of the invention, than with the idea of illustrating the specific construction and arrangement of parts that would be employed in practice. The symbols (+) and (—) are employed to indicate connections to the positive and negative terminals respectively of suitable batteries or other sources of direct current, and the symbol (B+) is used to indicate connection to the positive terminal of a high voltage power supply used in the radar equipment employed, the negative terminal of this supply being assumed to be connected to ground. The sequence charts of FIGS. 3A and 3B, 5A and 5B and 7A and 7B are conventional diagrams illustrating typical relative times of operation and energization of the relays, the filled-in portion relative to each relay being indicative of energization of the relay winding.

With reference to FIG. 1A, a stretch of railway track is illustrated comprising track rails 20 and 21. Associated with these track rails is a car retarder mechanism CRM which may be of any suitable type, such as is disclosed, for example, in the patent to W. K. Howe, No. 1,852,572, dated April 5, 1932.

A car retarder operating mechanism ROM is illustrated as being provided for governing the degree of retardation to be applied by the car retarder mechanism CRM. This retarder operating mechanism ROM selectively operates the retarder CRM to four different positions in accordance with the application of energy to the respective wires 0, 2, 3, and 4. These positions of the car retarder mechanism are respectively open, light braking, medium braking and heavy braking. Although any suitable operating mechanism may be employed for operating the retarder to these different positions, a control system such as is disclosed in the patent to W. K. Howe, No. 2,038,112, dated April 21, 1936, may be employed.

The car retarder CRM may be assumed as being any one of the retarders conveniently provided in a hump classification yard, but more particularly, for the purpose of explanation of the present invention, this may be assumed to be the first retarder off of the hump, and the direction of traffic will be assumed as being left to right as indicated by the arrows along the side of the various track diagrams.

A weighing mechanism WM is associated with a weighing rail WR at the entrance end of the retarder in a manner to weigh the load applied to the respective right hand wheels of the cars as the cars approach the retarder, and thereby feed information to the system for use in determining the degree of retardation that may be required. The structure and organization of the weighing rail WR and the weighing mechanism WM may be of any suitable type, the weighing rail WR being disposed adjacent the main rail 20 so that the rim of each car wheel rides up onto the weighing rail and thereby causes actuation of the weighing mechanism WM. The weighing mechanism WM is illustrated as having an axially operable shaft 22 carrying a compression spring 30 and a contacting plunger 23 which selectively makes contact between a common contact finger 24 and respective lightweight, medium weight, and heavy weight indicating contact fingers 25, 26 and 27.

An entering photocell unit EPC including a normally energized relay EPCR is provided in association with the entrance end of the retarder CRM as illustrated in FIG. 1A so that this relay EPCR is normally maintained energized in accordance with the uninterrupted beam

of light 28 extending across the track rails at substantially coupling height and emitted by a suitable lamp 29.

Similarly a normally energized leaving photocell unit LPC is associated with the exit end of the car retarder. This unit includes a normal energized relay LPCR which is maintained energized in accordance with the uninterrupted beam of light 31 extending across the track rails substantially at coupling height and emitted from a suitable lamp 32.

The system comprises radar speed responsive apparatus of the class sometimes known as an "interferometer" which has associated therewith a suitable directional antenna DA which renders the radar speed responsive apparatus operable to indicate the speed of a railway car whenever the car is within the limits of the respective entering and leaving photocell units EPC and LPC respectively. This radar speed responsive apparatus may be of any suitable type known in the art for indicating the speed of vehicles and the like. For the purpose of the disclosure of the present invention, however, the radar speed responsive apparatus is assumed to be of the type disclosed in the application of Kendall and Auer, Ser. No. 359,162, filed June 2, 1953, to which reference is made for a specific disclosure of the radar speed responsive apparatus. The directional antenna DA is of the horn type, preferably located between the rails near the leaving end of the retarder, and director toward the entering end. Speed of cars approaching and passing through the car retarder is indicated by the radar speed responsive apparatus by the energization of speed relays LS, MS and HS which respond to relatively low, medium and high speeds respectively, and a check relay CK which responds to the presence of a car moving at substantially any speed. The control of these low, medium, and high speed relays LS, MS, and HS respectively is accomplished through suitable highpass electronic filters L-MPH, M-MPH and H-MPH respectively as is fully disclosed in the above mentioned Kendall et al. application. It will, therefore, be apparent that relay LS is picked up when a car is within range of the radar apparatus and travelling above a predetermined relatively low speed; relay MS is picked up when a car is within range of the radar apparatus and travelling above a predetermined medium speed; relay HS is picked up when a car is within range of the radar apparatus and travelling above a predetermined high speed; and relay CK is picked up when a car is within range of the radar equipment and is in motion at any speed.

To provide an auxiliary manual control for the operation of the car retarder mechanism CRM, a manual control lever MCL is provided having a left hand automatic position wherein the automatic control of the retarder is effective and clockwise operated positions for selectively governing application of energy to the wires 0, 2, 3, and 4 for the manual control of the degree of retardation to be applied.

Relays EPCP and LPCP are provided as back contact repeaters of the entering photocell relay EPCR and the leaving photocell relay LPCR respectively. Relay LPCP has associated therewith a slow dropping away repeater relay LPCPP.

Two banks of weight relays W are provided, the relays 1LW, 1MW, and 1HW constitute one bank of weight relays. This bank is associated with the storage of the weight of a first car to be acted upon by the car retarder and also is more directly associated with governing the operation of the car retarder; while the relays 2LW, 2MW, and 2HW which constitute the second weight storage relay bank are used principally to store temporarily the weight of a second car which actuates the weighing mechanism WM prior to a first car having left the car retarder CRM.

Although the weight storage relays 1LW, 1MW, and 1HW, 2LW, 2MW, and 2HW have been illustrated as being governed directly by a weighing mechanism WM, it is to be understood that these relays could as well be governed by some other source of weight operation, such,

for example, as by the manual act of an operator knowing the weight of the cars, or by information automatically fed to the relays.

Relays Z and ZP are provided for selecting the proper weight storage relay bank to be responsive to the actuation of the weighing mechanism WM.

A transfer relay TF is provided for facilitating the transfer of weight storage from the second weight storage relay bank to the first weight storage relay bank.

Having considered the general organization of the system, more detail consideration of the organization will be given upon consideration of the mode of operation of the system under typical operating conditions.

Operation

When the system is inactive, when the lever MCL is in its left-hand position for automatic operation and when there is no car sufficiently in approach to have actuated the radar speed responsive apparatus, the car retarder mechanism CRM is in its heaviest braking position in accordance with the application of energy to the wire 4 extending to the car retarder CRM operating mechanism ROM. The circuit by which energy is applied to wire 4 under these conditions includes contact arm 34 of the manual control switch MCL and back contact 35 of relay CK. With the car retarder CRM normally in this maximum braking position, it is provided that if a car should be released when the radar speed responsive apparatus, for example, should not be operating, the car would be retarded so that no damage would be done by the failure of the retarder to operate in accordance with the approach of the car.

To consider a typical operating condition, it will be assumed that lever MCL is in its left-hand position and that a car approaches the car retarder and intercepts the light 28 and causes the relay EPCP to be dropped away. Upon the dropping away of this relay, relay EPCP becomes picked up upon the closure of back contact 36. The picking up of this relay permits the picking up of relay CK, which is associated with the radar speed responsive apparatus, by the closure of front contact 37. As has been pointed out, relay CK is energized in an electronic circuit of the radar speed responsive apparatus whenever a moving car is within the range of the apparatus, which is assumed to extend slightly beyond the location of the entrance photocell unit EPC. The picking up of relay CK is effective by the closure of its stick circuit to shunt front contact 37 of relay EPCP out of its control circuit so that relay CK is maintained picked up until the leaving photocell repeater relay LPCP is dropped away after passage of a car. This stick circuit includes front contact 97 of relay LPCP connected in multiple with back contact 98 of relay LPCPP and front contact 38 of relay CK.

When the first wheel of the car passes over the weighing rail WR, the actuating of the weighing mechanism WM (see FIG. 1B) is effective to selectively energize a weight relay 1LW, 1MW, 1HW, in accordance with the heaviest weight indicated by mechanism WM, it being assumed that the weight of the car is proportional to the weight applied by a single wheel passing over the weight rail. Then, if the weight of the car is light, only the relay 1LW is picked up by the energization of a circuit extending from (+), including back contacts 39, 40 and 41 of relays 2HW, 2MW and 2LW respectively, front contact 42 of relay EPCP, contact fingers 24 and 25 of the weighing mechanism WM, back contact 43 of relay Z, back contacts 132 and 133 of relay 1HW and 1MW respectively, and lower winding of relay 1LW, to (-). The picking up of this relay closes a stick circuit maintaining the relay 1LW picked up (unless a higher weight relay is subsequently energized) until the car leaves the car retarder CRM. This stick circuit extends from (+), including back contact 44 of relay LPCPP, back contact 45 of relay 1HW, back 46 of relay 1MW, front contact

47 of relay 1LW, and upper winding of relay 1LW, to (-).

If it is a medium weight car that passes over the weighing rail WR, the relay 1MW is picked up by the energization of a circuit extending from (+), including back contacts 39, 40 and 41 of relays 2HW, 2MW and 2LW respectively, front contact 42 of relay EPCP, contact fingers 24 and 26 of the weighing mechanism WM, back contact 48 of relay Z, back contact 134 of relay 1HW, and lower winding of relay 1MW, to (-). The picking up of this relay established a stick circuit for its upper winding including back contact 44 of relay LPCPP, back contact 45 of relay 1HW, and front contact 46 of relay 1MW. It will be noted that the picking up of relay 1MW opens the pickup and stick circuits for relay 1LW so that if relay 1LW has been picked up, it is immediately dropped away.

If the car passing over the weighing rail WR is a heavy car, relay 1HW is picked up by the energization of a circuit extending from (+), including back contacts 39, 40, and 41 of relays 2HW, 2MW and 2LW respectively, front contact 42 of relay EPCP, contact fingers 24 and 27 of the weighing mechanism WM, back contact 49 of relay Z, and lower winding of relay 1HW, to (-). The picking up of relay 1HW establishes a stick circuit for this relay extending from (+), including back contact 44 of relay LPCPP, front contact 45 of relay 1HW, and upper winding of relay 1HW, to (-). The picking up of relay 1HW opens the pickup and stick circuits for the relays 1MW and 1LW so that either of these relays will be dropped away if it has been picked up.

In accordance with the approach of a car at low speed, the relay LS becomes picked up by the energization of a high-pass electronic filtering system effective to cause energy to be applied to the relay LS at a particular low speed and at any speed above this particular low speed. It will be noted that the pick up circuit for relay LS includes back contact 50 of relay RC, and this back contact is shunted out upon the picking up of relay LS by the stick contact 51. The reason for the inclusion of back contact 50 of relay RC is to prevent a second actuation of the car retarder CRM for a car, after the car retarder CRM has been opened for the car, in a manner to be hereinafter more fully considered.

If the car is approaching the car retarder CRM at a medium speed, the medium speed relay MS is picked up by the radar speed responsive apparatus as well as the relays CK and LS, relay MS being picked up through back contact 52 of relay RC, and this back contact 52 being shunted by the stick contact 53.

Similarly, if the car approaching the car retarder approaches at high speed, relay HS is picked up in addition to the energization of relays CK, LS, and MS. Relay HS is picked up through back contact 54 of relay RC, and back contact 54 is shunted by the stick contact 55.

If it is a light weight car that is approaching the car retarder, and at low speed, the car retarder CRM is opened because of application of energy to the wire 0 through contact 34 of the switch MCL, front contact 35 of relay CK, back contact 56 of relay 1HW, back contact 57 of relay 1MW, front contact 58 of relay 1LW, and back contact 59 of relay HS. It will be noted that this circuit will be closed for the approach of a light car at either low or medium speeds, and is opened only when the light car is approaching at high speed so that back contact 59 of relay HS is opened.

If a light car is approaching the car retarder CRM at high speed, energy is applied to the control wire No. 2 to operate the retarder to its light braking position. Energy is applied to wire No. 2 under these conditions through the contact 34 of the switch MCL, front contact 35 of relay CK, back contacts 56 and 57 of relays 1HW and 1MW respectively, front contact 58 of relay 1LW, and front contact 59 of relay HS.

If a medium weight car is approaching the car retarder CRM at low speed, the car retarder CRM is opened in accordance with application of energy to the wire 0 through contact 34 of the switch MCL, front contact 35 of relay CK, back contact 56 of relay 1HW, front contact 57 of relay 1MW, and back contact 60 of relay MS.

If the medium weight car is proceeding at medium speed, energy is applied to the wire 2 for operating the car retarder CRM to its light braking position through contact 34 of switch MCL, front contact 35 of relay CK, back contact 56 of relay 1HW, front contact 57 of relay 1MW, front contact 60 of relay MS, and back contact 61 of relay HS.

In case the medium weight car is approaching the car retarder CRM at high speed, the car retarder CRM is operated to its medium braking position by application of energy to wire 3 through contact 34 of the switch MCL, front contact 35 of relay CK, back contact 56 of the relay 1HW, front contact 57 of relay 1MW, front contact 60 of relay MS, and front contact 61 of relay HS.

If it is considered that a heavy weight car is approaching the car retarder CRM at a speed below that required for the picking up of relay LS, the retarder is opened by application of energy to wire 0 through contact 34 of switch MCL, front contact 35 of relay CK, front contact 56 of relay 1HW, and back contact 62 of relay LS.

If a heavy weight car is approaching the car retarder CRM at low speed so as to cause the relay LS to be picked up, the car retarder mechanism CRM is operated to its medium braking position by application of energy to wire 3 through contact 34 of switch MCL, front contact 35 of relay CK, front contact 56 of relay 1HW, front contact 62 of relay LS, and back contact 63 of relay MS.

If a heavy weight car is approaching the car retarder CRM at medium or high speed, the car retarder CRM is actuated to its position for applying heavy braking by the application of energy to wire 4 through contact 34 of switch MCL, front contact 35 of relay CK, front contact 56 of relay 1HW, front contact 62 of relay LS, and front contact 63 of relay MS.

After the car has passed the entering photocell EPC, relay EPCR is restored to its picked up position, and relay EPCP is dropped away by the opening of its circuit at back contact 36. Upon the dropping away of this relay, the car retarder control relay RC becomes picked up by a circuit selected in accordance with the particular weight of car and speed in a combination whereby the relay RC is picked up if retardation is called for, but is not picked up if the speed and/or the weight is such that retardation is not called for. If, for example, retardation has been called for by a light weight car proceeding at high speed, relay RC is picked up by the energization of a circuit extending from (+), including back contact 64 of relay LPCPP, front contact 65 of relay HS, front contact 66 of relay 1LW, back contact 67 of relay 1MW, back contact 68 of relay 1HW, back contact 69 of relay EPCP, and winding of relay RC, to (-). This relay when picked up is maintained energized by a stick circuit extending from (+), including back contact 64 of relay LPCPP, front contact 70 of relay RC and winding of relay RC, to (-). Front contact 71 of relay LPCP is connected in multiple with back contact 64 of relay LPCPP for the purpose of maintaining the relay RC picked up until a car has cleared the exit photocell unit LPC. At this time, the relay LPCP drops away prior to the dropping away of its repeater relay LPCPP, and relay LPCPP is made slow to drop away so that relay RC has time to drop away upon the dropping away of relay LPCP.

If retardation has been caused by a medium weight car proceeding at medium or high speed, relay RC is picked up when the car has cleared the entering photocell unit EPC by the energization of a circuit extending from (+), including back contact 64 of relay LPCPP, front contact 72 of relay MS, front contact 67 of relay 1MW, back contact 68 of relay 1HW, back contact 69 of relay EPCP, and winding of relay RC, to (-).

If it is a heavy weight car that has caused retardation, relay RC is picked up by the energization of a circuit extending from (+), including back contact 64 of relay LPCPP, front contact 73 of relay LS front contact 68 of relay 1HW, back contact 69 of relay EPCP, and winding of relay RC, to (-).

Relay RC when picked up prevents energization of any speed relay S that is not already picked up by the opening of the pick-up circuits for all of the speed relays S. Thus, the pick-up circuits for the relays LS, MS and HS are opened at back contacts 50, 52 and 54 respectively. Any of these relays that are picked up at the time when the relay RC is picked up are maintained by their stick circuits which have been described. It will thus be seen that the relay RC governs the operation of the retarder in such a manner that once retardation has been called for a particular car, having passed the entering photocell unit EPC, and after the retarder has been opened upon reduction of speed for the car, with the relay RC picked up, a second retarder application for that car cannot be effected, even though the car may increase its speed in passing through the open retarder to a point which would cause the picking up of a speed relay LS, MS or HS which would call for retardation if it were not for the fact that the speed relay pick-up circuits are open because of the energization of relay RC. This provides what is conveniently called "single shot" operation in that the retarder cannot be closed for the second time for the passage of any one car after it has once been opened.

Relay Z is picked up after a car clears the entering photocell unit EPC by the energization of a circuit extending from (+), including back contacts 39, 40 and 41 of relays 2HW, 2MW and 2LW respectively, back contact 42 of relay EPCP, back contact 74 of relay ZP, front contact 75 of relay 1LW, or front contact 76 of relay 1MW or front contact 77 of relay 1HW, and upper winding of relay Z, to (-). This relay when picked up is maintained energized by a stick circuit for its lower winding including front contacts 78, 79, 80 and 89 of relays 1LW, 1MW, and 1HW and RC connected in multiple, and front contact 81 of relay Z. This maintains relay Z picked up as long as retardation is called for by the energization of the retarder control relay RC or as long as there is a weight storage set up by the energization of any one of the relays 1LW, 1MW or 1HW.

Relay Z, when picked up, causes the picking up of its repeater relay ZP (provided there is no weight storage for the second weight storage group of relays), by the energization of a circuit extending from (+), including back contacts 82, 83 and 84 of relays 2HW, 2MW and 2LW respectively, back contact 85 of relay TF, back contact 86 of relay EPCP, front contact 87 of relay Z, and lower winding of relay ZP, to (-). The picking up of relay ZP closes a stick circuit for this relay extending from (+), including front contact 88 of relay ZP, front contact 87 of relay Z, and lower winding of relay ZP, to (-).

When a car leaves the car retarder CRM, the photocell unit LPC is actuated, and relay LPCP is picked up in accordance with the closure of back contact 90 of relay LPCR. The picking up of relay LPCP causes the picking up of its repeater relay LPCPP in accordance with the closure of front contact 91, and relay LPCPP when picked up is maintained energized when relay RC is picked up by a stick circuit extending from (+), including front contact 92 of relay RC, front contact 93 of relay LPCPP, and lower winding of relay LPCPP, to (-). This relay is also maintained picked up under conditions of close following cars where the weight relays 2LW, 2MW and 2HW are selectively energized by a stick circuit including front contact 39 of relay 2HW, or front contact 40 of relay 2MW or front contact 41 of relay 2LW, back contact 94 of relay TF, and front contact 93 of relay LPCPP. Relay LPCPP is made slow to

drop away by the shunting of its upper winding through front contact 95.

When the rear end of a car, considering passage of a single car, clears the beam 31 governing the photocell unit LPC, relay LPCP becomes dropped away by the opening of its circuit at back contact 90, and the dropping away of this relay with relay LPCPP picked up, opens the stick circuits for relays RC and CK at front contacts 71 and 97 respectively, and causes the dropping away of these relays. The dropping away of relay RC at this time conditions the speed relays S for energization in accordance with the speed of the next car that may come within the range of the radar speed responsive apparatus. The dropping away of relay LPCP also causes the dropping away of whichever of the weight relays 1LW, 1MW, or 1HW is picked up by the opening of front contact 96, the back contact 44 of relay LPCPP which is connected in multiple with front contact 96 of relay LPCP being opened at this time.

Relay RC in dropping away causes the dropping away of relay Z, by the opening of its stick circuit at front contact 89, energy having been removed from the contacts 78, 79, and 80 of the weight relays 1LW, 1MW, or 1HW. The dropping away of relay Z causes the dropping away of relay ZP by opening the circuit for the lower winding of this relay at front contact 87.

Upon the dropping away of relay CK, the closure of back contact 35 applies energy to wire 4 for the operation of the car retarder CRM to its predetermined normal braking position. Thus the apparatus is restored to its normal condition after passage of a single car.

Considering now the mode of operation for the traffic condition illustrated in FIG. 4, for example, where several cars are coupled together, it will be readily apparent from the sequence charts of FIGS. 5A and 5B that the mode of operation under these conditions is similar to that which has been described, except that there is the possibility of the degree of retardation being changed in accordance with a heavier weight being indicated by the second or third car, for example, than is initially detected upon weighing the first wheel of the first car. This condition can exist for a single car, for example, where the weight is unequally distributed in the car, being mostly applied over the rear truck. In any case, where a heavy weight is detected subsequent to the setting of the retarder by the detection of a lighter weight, it is possible that a heavier retardation may be called for. If, on the other hand, the first car of a cut is heavy and the following cars are light, there is no change of the degree of retardation directly attributed to the weighing of the light cars.

To consider a typical operating condition to illustrate the above described mode of operation, a traffic condition will be assumed such as is illustrated in FIG. 4, wherein the first car in the cut is a medium weight car and thus calls for the operation of the car retarder CRM in accordance with the application of energy to wire No. 2. The circuits calling for this degree of retardation in accordance with the progress of the car at medium speed has been described.

According to the sequence chart of FIGS. 5A and 5B, it has been assumed that the speed of the cut increases from medium speed to a high speed. This can readily be the case because of the heavy car that is included in the cut. Inasmuch as the retarder control relay RC has not yet been picked up, it is possible to pick up the speed relay HS at this time, and thus the condition is set up where all three of the speed relays LS, MS, and HS are in their picked up positions. The picking up of relay HS calls for another degree of retardation, and in accordance therewith, energy is applied to wire No. 3 for operation of the car retarder CRM to a position applying the next higher degree of braking.

It is next assumed, in the condition illustrated by the sequence chart of FIGS. 5A and 5B, that the second car (heavy weight) is weighed, and the relay 1HW (see FIG.

1B) is picked up by the energization of a pick up circuit that has been described. The picking up of relay 1HW causes the dropping away of relay 1MW by the opening of its pickup circuit at back contact 134 and its stick circuit at back contact 45. Relay 1HW is effective by the closure of its front contact 56, to apply energy to wire No. 4 to cause the car retarder CRM to be operated to its maximum braking position. The circuit by which energy had been applied to wire No. 3 is opened by the picking up of relay 1HW at back contact 56.

It is assumed according to the sequence charts of FIGS. 5A and 5B that shortly after the high degree of retardation is applied, the speed of the car is reduced so that the high speed relay HS is dropped away, but this does not reduce the degree of retardation, as the presence of a heavy car in the cut requires retardation to be continued at its maximum until the dropping of the medium speed relay MS. The dropping away of this relay permits the reduction in the degree of retardation of the retarder by the application of energy to wire No. 3. The retarder is maintained in the position to which it is operated by application of energy to wire No. 3 until the speed of the cut of cars is reduced to the extent where the low speed relay LS becomes dropped away, and at this time energy is removed from wire No. 3 by the opening of front contact 62, and applied to wire No. 0 by the closure of back contact 62, to provide for the opening of the retarder CRM completely to permit the cut of cars to proceed with no further braking being applied.

Because of the light beam 28 for control of the photocell unit EPC being passed across the trackway at coupler height as has been described, the relay EPCP is maintained picked up from the time the light beam 28 is first intercepted until the rear of the last car of the cut has passed the location of the photocell unit EPC. Thus, it is not until the last car has passed the entering photocell unit EPC that the relay EPCP is dropped away to cause the picking up of relay RC so as to prevent a second actuation of the retarder until the cut of cars has passed the exit point. It will thus be seen from the description as it has been set forth and from the sequence chart of FIGS. 5A and 5B that the mode of operation upon the passage of a cut of cars is the same as for a single car of a comparable length, provision being made to increase the degree of retardation in accordance with heavier weights of cars as they are detected in passing over the weighing rail WR or by an increase in speed until the last car of the cut has cleared the light beam 28.

Consideration will now be given to the mode of operation under conditions where a second car is weighed prior to the leaving of the car retarder CRM by a first car under a traffic condition such as is illustrated, for example, in FIG. 6. A different problem exists here than in the case where the cars are coupled together in that the cars may be travelling at different speeds, and if the retardation of the first car were to be governed by a heavier second car, the first car, which might be light, might be stopped in the retarder, and under these conditions a close following second car travelling at rather high speed could cause damage upon colliding with the first car within the car retarder CRM. The organization, therefore, is such that the weight of the second car is stored by the second bank of storage relays, 2LW, 2MW, and 2HW, but this weight cannot be used to influence the degree of retardation applied by the retarder until the first car has cleared the leaving photocell unit LPC.

If the second car to be weighed under the above described traffic conditions is light, relay 2LW is picked up by the energization of a circuit extending from (+), including front contact 99 of relay ZP, front contact 42 of relay EPCP, contacts 24 and 25 of the weighing mechanism WM, front contact 43 of relay Z, front contact 100 of relay ZP, and lower winding of relay 2LW, to (-). Upon the picking up of relay 2LW, a stick circuit is established for this relay extending from (+), including back

contact 101 of relay TF, back contacts 102 and 103 of relays 2HW and 2MW respectively, front contact 104 of relay 2LW, to (-). Relay 2LW in picking up also established a stick circuit by which this relay is maintained picked up as long as the relays Z and ZP are picked up. This stick circuit extends from (+), including front contact 105 of relay 2LW, front contact 43 of relay Z, front contact 100 of relay ZP and lower winding of relay 2LW, to (-).

If the second car is of medium weight, the medium weight relay 2MW is picked up in accordance with the energization of a circuit extending from (+), including front contact 99 of relay ZP, front contact 42 of relay EPCP, contact fingers 24 and 26 of the weighing mechanism WM, front contact 48 of relay Z, front contact 106 of relay ZP, and lower winding of relay 2MW, to (-). This relay when picked up closes a stick circuit for its upper winding extending from (+), including back contact 101 of relay TF, back contact 102 of relay 2HW, front contact 103 of relay 2MW, and upper winding of relay 2MW, to (-). A stick circuit is closed for the lower winding of relay 2MW extending from (+), including front contact 107 of relay 2MW, front contact 48 of relay Z, front contact 106 of relay ZP, and lower winding of relay 2MW, to (-).

If the second car is heavy, the relay 2HW is picked up in accordance with the energization of a pick up circuit extending from (+), including front contact 99 of relay ZP, front contact 42 of relay EPCP, contact fingers 24 and 27 of weighing mechanism WM, front contact 49 of relay Z, front contact 108 of relay ZP, and lower winding of relay 2HW, to (-). This relay when picked up is maintained energized by a stick circuit extending from (+), including back contact 101 of relay TF, front contact 102 of relay 2HW, and upper winding of relay 2HW, to (-). Another stick circuit is closed for relay 2HW extending from (+), including front contact 109 of relay 2HW, front contact 49 of relay Z, front contact 108 of relay ZP, and lower winding of relay 2HW, to (-).

As soon as the second car has cleared the light beam governing the operation of the photocell EPC, the dropping away of relay EPCP is effective to cause relay ZP to have its upper winding energized with a polarity to cause this relay to be driven down. The circuit by which the upper winding of relay ZP is energized under these conditions extends from (+), including front contact 99 of relay ZP, back contact 42 of relay EPCP, front contact 74 of relay ZP, front contacts 110, 111, and 112 of relays 2LW, 2MW, and 2HW connected in multiple, and upper winding of relay ZP, to (-). Once the flux has been neutralized so that this relay drops away, the stick circuit for its lower winding is opened at front contact 88 so it cannot again be picked up and the drive down circuit is open at front contact 99. Relay Z cannot be dropped away at this time, however, because this relay is maintained picked up in accordance with front contact 89 of relay RC being closed or front contact 78 of relay 1LW, or front contact 79 of relay 1MW, or front contact 80 of relay 1HW. It will be noted from the mode of operation of the system that has been described that the relay RC is picked up upon the first car clearing the entering photocell unit EPC and is maintained picked up until the first car clears the leaving photocell unit LPC. In this manner, the weight of the first car is maintained stored in the storage relay bank comprising relays 1LW, 1MW and 1HW, and this being the only weight storage bank that can govern the degree of retardation applied by the car retarder CRM, the car retarder CRM cannot be influenced by the second car until the first car has cleared the leaving photocell LPC and thus permitted the clear-out of the storage for the first car and the transfer of the storage for the second car to the relays 1LW, 1MW, and 1HW so that the car retarder CRM can be governed according to the weight of the second car.

To consider more specifically the above described mode

of operation, relay RC becomes dropped away upon the dropping away of relay LPCP by the opening of front contact 71. The dropping away of relay LPCP also causes the dropping away of whichever one of relays 1LW, 1MW or 1HW is picked up by the opening of front contact 96. Thus with all of the relays 1LW, 1MW and 1HW and RC dropped away, the stick circuit for relay Z is open and this relay becomes dropped away. The dropping away of relay Z closes circuits to transfer the weight storage which has been maintained for the second car to the first storage bank of relays comprising relays 1LW, 1MW and 1HW. Thus if relay 2LW, for example, has been picked up in accordance with the weight of the second car being light, the relay 1LW becomes picked up upon the dropping away of relay Z by the energization of a circuit for its lower winding extending from (+), including front contact 105 of relay 2LW, back contact 43 of relay Z, back contact 132 of relay 1HW, back contact 133 of relay 1MW, and lower winding of relay 1LW, to (-). If it is the relay 2MW that has been energized in accordance with the second car being a medium weight car, the relay 1MW is picked up at this time in accordance with the closure of a circuit for its lower winding including front contact 107 of relay 2MW, back contact 48 of relay Z, and back contact 134 of relay 1HW. Similarly if the second car is a heavy weight car, the relay 1HW is picked up in accordance with the closure of a circuit including front contact 109 of relay 2HW, and back contact 49 of relay Z.

When a relay 1LW, 1MW or 1HW is picked up in correspondence with a similar weight relay 2LW, 2MW or 2HW, a pick-up circuit is closed for the transfer relay TF proving that transfer has been completed. If the second car is a light weight car, the pick-up circuit for relay TF extends from (+), including back contact 113 of relay Z, front contact 114 of relay 1LW, front contact 115 of relay 2LW, back contacts 116 and 117 of relays 2MW and 2HW respectively, and lower winding of relay TF, to (-). This relay when picked up is maintained energized by a stick circuit extending from (+), including back contact 82 of relay 2HW, back contact 83 of relay 2MW, front contact 84 of relay 2LW, front contact 118 of relay TF, and upper winding of relay TF, to (-). If the second car is a medium weight car, the pick-up circuit for relay TF extends from (+), including back contact 113 of relay Z, front contact 119 of relay 1MW, front contact 116 of relay 2MW, back contact 117 of relay 2HW, and lower winding of relay TF, to (-). The stick circuit for relay TF for a medium weight car extends from (+), including back contact 82 of relay 2HW, front contact 83 of relay 2MW, front contact 118 of relay TF, and upper winding of relay TF, to (-). If the second car is a heavy weight car, the pick-up circuit for relay TF extends from (+), including back contact 113 of relay Z, front contact 120 of relay 1HW, front contact 117 of relay 2HW, and lower winding of relay TF, to (-). The stick circuit for relay TF when the second car is heavy includes front contact 82 of relay 2HW and front contact 118 of relay TF.

The picking up of relay TF opens the stick circuits that have been described for relays 2LW, 2MW, and 2HW at back contact 101, and the shifting of this contact applied energy to the stick circuits for relays 1LW, 1MW and 1HW to maintain these relays picked up. The relay 2LW, or 2MW, or 2HW which has been energized does not drop away immediately, however, because of the relay LPCPP being maintained picked up by its shunted upper winding for a time to apply energy to the stick circuits of relays 2LW, 2MW and 2HW through front contact 44. Relay LPCPP is deenergized upon the opening of its circuit at back contact 94 of relay TF.

After relay LPCPP has had time to drop away, whichever one of the relays 2LW, 2MW or 2HW that have been picked up is dropped away by the opening of its stick circuit at front contact 44, and the transfer relay TF is in

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turn dropped away because of the opening of its stick circuit by the dropping away of one of the relays 2LW, 2MW or 2HW. It will be noted that prior to the dropping away of relay TF the back contact 44 of relay LPCPP has been closed to provide stick energy for the relays 1LW, 1MW and 1HW so that whichever of these relays is picked up is maintained picked up after the transfer process has been completed.

It will be readily understood that immediately upon the picking up of a relay 1LW, 1MW or 1HW corresponding to that weight of the second car as has been described, the car retarder CRM is operated to a position in accordance with the weight of the second car, and in accordance with the speed of the car as determined by the radar speed responsive apparatus. This mode of operation in controlling the car retarder CRM is the same as has been described when considering passage of a single car through the retarder.

When retardation is called for for the second car, relay RC is again picked up in accordance with the normal mode of operation, and clear out of the apparatus when the second car leaves is in accordance with the mode of operation as it has been described for the passage of a single car.

In the embodiment of the invention illustrated in FIG. 8, it is to be understood that the system includes the same apparatus that has been described with reference to FIGS. 1A and 1B, except that the leaving photocell unit LPC of FIG. 1A has been replaced with the exit relay EX of FIG. 8. Thus this relay EX replaces relay LPCP of FIG. 1A and performs the same functions in the system as the relay LPCP. In FIG. 8, the wires 121 to 130 inclusive correspond to similarly identified wires of FIGS. 1A and 1B.

The control of the exit relay EX by the radar speed responsive apparatus, or interferometer, is preferably adjusted so that this relay is in its picked up position when and only when a car is within a very short distance, such as about ten feet, for example, ahead or in the rear of the directional antenna DA. In other words, a particularly strong signal is required in order that the exit relay EX may be picked up, but this relay is picked up irrespective of the car speed. It is preferable that the directional antenna DA be sufficiently close to the exit end of the car retarder CRM that the exit relay EX is dropped away just as a car leaves the car retarder CRM. The exact point at which the relay EX is picked up is of little consequence as it is the dropping away of this relay, as has been described for the corresponding relay LPCP, that provides the function of cancellation of the car retarder control for a car that has just left the car retarder CRM.

The detail circuit organization for the control of the exit relay EX is fully disclosed for a relay identified by a similar reference character in the above mentioned Kendall et al. application Ser. No. 359,162, filed June 2, 1953, to which reference may be made for a more complete disclosure.

It will be readily apparent that the system is operable as intended for the usual type of traffic, irrespective of the number of cars in different cuts, as long as there is a reasonable space between cars. It will be noted that a substantial space between successive cars, or cuts of cars, is required according to normal hump yard practice in order to have time for operation of the track switches as required to send the cars to different classification tracks.

Conditions may arise, however, where a second car may catch up with a first car within the retarder, thus being counted as a single car leaving the retarder as compared to two cars having been counted in. To clear the system after this abnormal operation, the operator has only to operate his manual control lever MCL momentarily to a manual control position and thereby remove battery from all of the low voltage relays by the opening of contact 136 of lever MCL. Having thus cleared the system, the lever MCL can be restored to the automatic position in which it is shown in FIG. 1A and the system is in condition for operation upon passage of the next car.

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Having thus described two specific embodiments of the present invention, it is desired to be understood that the present invention is not limited to the specific forms shown and that various adaptations, alterations, and modifications may be made to the specific forms shown within the scope of the present invention, except as limited by the scope of the appending claims.

What I claim is:

1. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means at the entering end of the car retarder and leaving detector means at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means conditioned in accordance with the speed of a car only provided that the car is within the limits of said entering detector means and said leaving detector means, a bank of weight storage relays, means for selectively energizing said weight storage relays in accordance with the weight of a car approaching said car retarder, and circuit means for governing the degree of operation of said operating mechanism in accordance with the weight of a car as indicated by the condition of said weight storage relays and in accordance with the speed of a car as detected by said speed responsive means.

2. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means conditioned in accordance with the speed of a car at any instant when passing within the limits of said entering detector means and said leaving detector means, a weighing mechanism disposed in said stretch of track at the entering end of the car retarder, weight storage means including a bank of weight storage relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of the car as indicated by the condition of said storage relays and in accordance with the speed of the car as determined by said speed responsive means, said circuit means being rendered effective only provided a car is within the limits of said entering detector means and said leaving detector means.

3. A car retarder control system comprising in combination, a stretch of railway track including a track brake type car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means at the entering end of the car retarder having a photocell subject to actuation by a beam of light projected across the trackway at coupler height, leaving detector means subject to actuation by cars leaving said car retarder, radar speed responsive means distinctively conditioned in accordance with the speed of a car when passing within the limits of said entering detector means and said leaving detector means, said radar speed responsive means having speed relays selectively governed in accordance with the speed of a car, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the speed of a car as determined by said radar speed responsive relays, said circuit means being rendered effective only provided a car is within the limits of said entering detector means and said leaving detector means.

4. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, said entering detector means being subject to actuation by each of a plurality of cars entering the car retarder successively at close intervals only provided that the cars are uncoupled, radar speed responsive means having speed relays selectively operable in response to different traveling speeds of a car when it is between said entering detector means and said leaving detector means, and circuit means for governing the degree of retardation of said multiple position operating mechanism provided that a car is within the limits of said entering and leaving detector means in accordance with the speed of the car as determined by said speed relays.

5. A car retarded control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means at the entering end of the car retarder having a photocell subject to actuation by a beam of light projected across the trackway at coupler height, leaving detector means subject to actuation by cars leaving said car retarder, radar speed responsive means distinctively conditioned in accordance with the speed of a car when passing within the limits of said entering detector means and said leaving detector means, a weighing mechanism disposed in said stretch of track at the entering end of the car retarder, weight storage means including a bank of weight storage relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of said weight storage relays and in accordance with the speed of the car as determined by said radar speed responsive means, said circuit means being rendered effective only provided a car is within the limits of said entering detector means and said leaving detector means.

6. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means at the entering end of the car retarder and leaving detector means at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna with a radiation pattern such as to render said radar speed responsive means responsive to a car within the limits established by said entering detector means and said leaving detector means, said speed responsive means having speed relays selectively responsive to different traveling speeds of a car within the range of said radar speed responsive means, and circuit means for governing the degree of operation of said multiple position operating mechanism provided that a car is within the limits of said entering detector means and said leaving detector means in accordance with the speed of the cars as determined by said relays.

7. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means

at the entering end of the car retarder and leaving detector means at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna located between the track rails near one end of the car retarder and directed toward the opposite end of the car retarder, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car within the range of said radar speed responsive means, and circuit means for governing the degree of operation of said multiple position operating mechanism provided that a car is within the limits of said entering detector means and said leaving detector means in accordance with the speed of the car as determined by said speed relays.

8. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation applied to a car by said retarder, entering detector means at the entering end of said car retarder subject to actuation by cars approaching said car retarder, radar speed responsive means having a directional antenna with a radiation pattern covering the area of said car retarder and extending to the location of said entering detector means, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car, a weighing mechanism independent of said entering detector means and disposed in said stretch of track at the entering end of the car retarder, weight storage means including a bank of weight storage relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of the car as indicated by the condition of said storage relays and in accordance with the speed of a car as determined by said radar speed responsive apparatus, said circuit means being rendered effective only provided a car has actuated said entering detector means.

9. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna with a radiation pattern such as to render said radar speed responsive means responsive to a car between the limits established by said entering detector means and said leaving detector means, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car within the range of said radar speed responsive means, a weighing mechanism disposed in said stretch of track at the entering end of the car retarder, weight storage means including a bank of weight storage relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of the car as indicated by the condition of said storage relays and in accordance with the speed of the car as determined by said speed relays, said circuit means being effective only provided that a car is within the limits of said entering detector means and said leaving detector means.

10. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a

given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna located near one end of the car retarder and directed toward the opposite end of the car retarder, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car within the range of said radar speed responsive means, a weighing mechanism disposed in said stretch of track at the entering end of the car retarder, weight storage means including a bank of weight storage relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism when a car is within the limits of said entering detector means and said leaving detector means in accordance with the weight of the car as indicated by the condition of said storage relays and in accordance with the speed of the car as determined by said speed relays.

11. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having entrance and exit ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation to be applied to a car passing through the car retarder, entrance detector means at the entering end of the car retarder and exit detector means at the exit end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having speed relays selectively operable in response to different speeds of car movement within the limits of said entrance and exit detector means, circuit means for governing the degree of operation of said multiple position operating mechanism provided that a car is within the limits of said entrance and exit detector means in accordance with the speed of the car as determined by said speed relays, and means effective when all of said speed relays are deenergized to operate said operating mechanism to one position if a car is between said entrance and said exit detector means and to another position after said exit detector means has been actuated.

12. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having entrance and exit ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation to be applied to a car passing through the car retarder, entrance detector means and exit detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having speed relays selectively operated in response to different speeds of car movement within the limits of said entrance and exit detector means, a weighing mechanism disposed in said stretch of track at the entrance end of the car retarder, weight storage means including a bank of weight storing relays selectively energized in accordance with the actuation of said weighing mechanism by a car and maintained energized while the car is passing through the retarder, circuit means for governing the degree of operation of said multiple position operating mechanism provided that a car is within the limits of said entrance and exit detector means in accordance with the weight of the car as indicated by the condition of said storage relays and in accordance with the speed of the car as determined by said speed relays, and means effective when all of said speed relays are deenergized to operate said operating mechanism to one position provided that a car is within the limits of said entrance and exit detector means and to another position after said exit detector means has been actuated by that car.

13. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means subject to actuation by cars approaching said car retarder, radar speed responsive means having a directional antenna with a radiation pattern including the area of said car retarder and extending to said entering detector means, said radar speed responsive means having speed relays selectively operable in response to different travelling speeds of a car travelling within the area of said radiation pattern, and said radar speed responsive means having a check relay energized in response to movement of a car at any speed within the limits of said radiation pattern provided that the car has actuated said entering detector means, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the speed of a car as determined by said speed responsive relays, said circuit means being rendered effective only provided that a car has actuated said entering detector means, and said circuit means being effective to operate said car retarder to a predetermined braking position upon the deenergization of said check relay.

14. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means subject to actuation by cars approaching said car retarder, radar speed responsive means having a directional antenna with a radiation pattern including the area of said car retarder and extending to said entering detector means, said radar speed responsive means having speed relays selectively operable in response to different travelling speeds of a car travelling within the area of said radiation pattern, and said radar speed responsive means having a check relay energized in response to movement of a car at any speed within the limits of said radiation pattern provided that the car has actuated said entering detector means, weight storage means including a bank of weight storage relays selectively energized in accordance with the weight of a car and maintained energized while the car is passing through the car retarder, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of said storage relays and in accordance with the speed of a car as determined by said speed responsive relays, said circuit means being rendered effective only provided that a car has actuated said entering detector means, and said circuit means being effective to operate said car retarder to a predetermined braking position upon the deenergization of said check relay.

15. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, said entering detector means being subject to actuation by each of a plurality of cars entering the car retarder successively at close intervals but uncoupled and being subject to actuation for a cut of cars coupled together as if it were a single car, speed responsive means having speed relays selectively operable in response to different travelling speeds of a car when it is between said entering detector means and said leaving detector means, respective first and second banks of weight storage relays, circuit means for selectively actuating said first bank of weight storage relays in accordance with the weight of a car having actuated said entering detector means only provided that the next pre-

ceding car has actuated said leaving detector means, circuit means of selectively actuating said second bank of weight storage relays in accordance with the weight of a car having actuated said entrance detector means only provided that said leaving detector means has not been actuated by the next preceding car, means for transferring the weight storage from said second storage relay bank to said first storage relay bank when said leaving detector means is actuated by a car, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of the relays of said first weight storage relay bank and in accordance with the speed of a car as determined by said speed responsive means.

16. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, speed responsive means having speed relays selectively operable in response to different travelling speeds of a car when travelling within the limits of said entering detector means and said leaving detector means, respective first and second banks of weight storage relays, circuit means for selectively actuating said first bank of weight storage relays in accordance with the weight of a car only provided that the next preceding car has actuated said leaving detector means, circuit means for selectively actuating said second bank of storage relays in accordance with the weight of a car only provided that said leaving detector means has not been actuated by the next preceding car, means for transferring the weight storage from said second storage relay bank to said first storage relay bank when said leaving detector means is actuated by a car, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of the relays of said first weight storage relay bank and in accordance with the speed of a car as determined by said speed responsive means.

17. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna with a radiation pattern such as to render said radar speed responsive means responsive to a car within the limits established by said entering detector means and said leaving detector means, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car within the range of said radar speed responsive means, respective first and second banks of weight storage relays, circuit means for selectively actuating said first bank of storage relays in accordance with the weight of a car having actuated said entering detector means only provided that the next preceding car has actuated said leaving detector means, circuit means for selectively actuating said second bank of storage relays in accordance with the weight of a car having actuated said entering detector means only provided that said leaving detector means has not been actuated by the next preceding car, means for transferring the weight storage from said second storage relay bank to said first storage relay bank when said leaving detector means is actuated by a car, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of the relays of said first weight storage relay

bank and in accordance with the speed of a car as determined by said speed relays.

18. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to operation by cars respectively approaching and leaving said car retarder, speed responsive means distinctively conditioned in accordance with the speed of a car when passing within the limits of said entering and leaving detector means, a bank of weight storage relays, means for selectively energizing said weight storage relays in accordance with the weight of a car approaching said car retarder, circuit means for governing the degree of operation of said operating mechanism in accordance with the weight of a car as indicated by the condition of said weight storage relays and in accordance with the speed of a car as detected by said speed responsive means, and means governed by said entering detector means for rendering the control of said car retarder operating mechanism ineffective in response to an increase in the speed of a car passing through the car retarder after the car has passed said entering detector means.

19. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to operation by cars respectively approaching and leaving said car retarder, speed responsive means distinctively conditioned in accordance with the speed of a car when passing within the limits of said entering and leaving detector means, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car, a bank of weight storage relays, means for selectively energizing said weight storage relays in accordance with the weight of a car approaching said car retarder, circuit means for governing the degree of operation of said operating mechanism in accordance with the weight of a car as indicated by the condition of said weight storage relays and in accordance with the speed of a car as determined by said speed responsive means, and car retarder control means including a car retarder control relay energized when a car clears said entering detector means, said control relay being effective when energized to prevent the picking up of one of said speed responsive relays in accordance with an increase in the speed of a car prior to the actuation by that car of the leaving detector means.

20. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to operation by cars respectively approaching and leaving said car retarder, speed responsive means distinctively conditioned in accordance with the speed of a car when passing within the limits of said entering and leaving detector means, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car, circuit means for governing the degree of operation of said operating mechanism in accordance with the speed of a car as indicated by the condition of said speed relays, and car retarder control means including a car retarder control relay energized when a car actuates said entering detector means provided that the speed of a car has been such as to call for retardation, said control relay being effective when energized to prevent the picking up

of any one of said speed relays that is not already energized at that time.

21. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means subject to actuation by cars approaching said car retarder, radar speed responsive means having a directional antenna located near one end of the car retarder and directed toward the opposite end of the car retarder, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car travelling within the area of the radiation pattern of said antenna, and said radar speed responsive means having an exit relay energized only in response to the presence of a moving car in close proximity to said antenna, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the speed of a car as determined by said speed responsive relays, said circuit means being rendered effective only provided that a car has actuated said entering detector means, and said circuit means being effective to operate said car retarder to a predetermined braking position in response to the actuation of said exit relay when a car leaves the car retarder.

22. A car retarder control system comprising in combination, a stretch of railway track including a car retarder having respective entering and leaving ends for a given direction of traffic and having a multiple position operating mechanism for governing the degree of retardation, entering detector means and leaving detector means subject to actuation by cars respectively approaching and leaving said car retarder, radar speed responsive means having a directional antenna located near one end of the car retarder and directed toward the opposite end of the car retarder, said speed responsive means having speed relays selectively operable in response to different travelling speeds of a car within the range of said radar speed responsive means, and said radar speed responsive means having an exit relay energized only when a car is in close proximity to said directional antenna, weight storage means including a bank of weight storage relays selectively conditioned in accordance with the weight of a car having actuated said entering detector means, and circuit means for governing the degree of operation of said multiple position operating mechanism in accordance with the weight of a car as indicated by the condition of said weight storage relays and in accordance with the speed of a car as determined by the condition of said speed responsive relays, said circuit means being rendered effective only provided that a car has actuated said entering detector means, and said circuit means being effective to operate said car retarder to a predetermined braking position in response to said exit relay being actuated by a car leaving the car retarder.

23. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having an entering end for a given direction of traffic, an entrance detector subject to actuation by the approach of a car to the entering end of said car retarder, radar speed responsive means for indicating the speed of a car in the immediate vicinity of said car retarder, said radar speed responsive means being operable to detect the presence of a moving car irrespective of its speed provided the car has actuated said entrance detector, circuit means rendered effective upon actuation of said entrance detector for opening said car retarder when the speed of a car has been reduced to a predetermined value as detected by said radar speed responsive means, and circuit means effective after a car has passed out of the vicinity of said car retarder as detected by said radar speed responsive means for operating said car retarder to its closed position.

24. A car retarder control system comprising, a stretch of railway track including a car retarder of the track brake type having an operating mechanism whereby the car retarder can be power operated between open and closed positions, radar speed responsive means having a directional antenna with a radiation pattern covering the area longitudinally along said stretch of track including said car retarder, said radar speed responsive means having a check relay subject to energization when a car is in motion at any speed within the vicinity of the car retarder, and said radar speed responsive means having a speed relay that is subject to actuation when the speed of a car within the car retarder is reduced to a given speed, and circuit means for operating said car retarder to an open position in response to the actuation of said speed relay and to a closed position when said check relay is deenergized.

25. A car retarder control system comprising in combination, a stretch of railway track including a car retarder of the track brake type having an entrance end for a given direction of traffic and having an operating mechanism whereby the car retarder can be power operated between open and closed positions, an entrance detector subject to actuation by the approach of a car to the entrance end of said car retarder, radar speed responsive means for indicating the speed of a car in the immediate vicinity of said car retarder, said radar speed responsive means having a check relay operable to detect the presence of a moving car irrespective of its speed provided the car has actuated said entrance detector, circuit means rendered effective upon the actuation of said entrance detector for opening said car retarder when the speed of a car has been reduced to a predetermined value as detected by said radar speed responsive means, and circuit means including said check relay for maintaining said car retarder closed except when said radar speed responsive means indicates the presence of a car.

26. A car retarder control system comprising, a stretch of railway track including a car retarder of the track brake type having respective entrance and exit ends for a given direction of traffic and having an operating mechanism whereby the car retarder can be power operated between open and closed positions, radar speed responsive means having a directional antenna located near one end of the car retarder and directed toward the opposite end of the car retarder, said speed responsive means having a check relay that is actuated whenever a moving car is in the vicinity of the car retarder and an exit relay that is actuated whenever a car is in close proximity to said antenna irrespective of its speed, and said speed responsive means having a speed relay that is subject to actuation in accordance with the reduction of the speed of a car to a given speed, and circuit means controlled by said check relay and said exit relay for maintaining said car retarder closed except when a car is in the vicinity of the car retarder, said circuit means being effective to open said car retarder in response to actuation of said speed relay.

27. In a car retarder control system having automatic car retarder control apparatus, a car retarder in a stretch of railway track, leaving detector means at the leaving end of the car retarder subject to actuation by cars leaving said car retarder for a given direction of traffic, an exit relay and an exit repeater relay associated with said leaving detector, circuit means for actuating said exit relay and said exit repeater relay successively in one order when the front end of a cut of cars passes said exit detector and in the opposite order when the rear end of that cut of cars passes said exit detector, and means for restoring said car retarder control apparatus to its normal condition in response to the actuation of said exit and exit repeated relays in said opposite order.

28. A car retarder control system comprising in combination, a stretch of railway track including a car retarder selectively operable to braking and non-braking

positions, high frequency speed responsive means having a transmitter with a radiation pattern including the area of the retarder for continuously generating a signal indicative of the speed of a car cut as it passes through the retarder, car retarder control means governed by said signal for operating said car retarder to its non-braking position when the speed of said car cut within the retarder is reduced to a predetermined value, detecting means at the exit end of the car retarder for determining when said car cut has vacated the retarder, and means controlled by said detector means for operating said car retarder to said braking position when the retarder becomes vacated by said car cut.

29. A car retarder control system for a railway classification yard having a car retarder selectively operable to braking and non-braking positions disposed at an intermediate point in a stretch of track leading from a hump to a classification track comprising, weight detecting means disposed in said stretch of track in approach of the retarder for registering and storing an analog of the weight classification of a car approaching the retarder, release speed selecting means controlled at least in part by said weight detecting means for selecting and storing an analog of the car release speed at which the retarder should be operated to a non-braking position, detection means including an entering detector at the entering end of the car retarder and a leaving detector at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder in a given direction for detecting when the stretch of trackway within the retarder has become unoccupied by a car, high frequency speed detecting means for substantially continuously generating a signal indicative of the speed of a car upon the passage of the car through the retarder, and retarder control means controlled by said signal and rendered effective by said detection means for operating said retarder to said non-braking position when the speed of the car as determined by said signal is reduced to the car release speed selected by said release speed selecting means, said retarder control means being controlled by said detection means to be effective to operate said retarder to said braking position when the portion of the stretch of track between the entering and leaving detectors becomes vacated upon the passage of a car cut.

30. In a system for the control of a retarder to control the braking pressure exerted thereby upon a car rolling by gravity through a classification yard and passing through said retarder and where the system is of the type wherein a desired release speed for said car from said retarder is determined prior to the entry of said car into said retarder, the improvement which comprises, detector means including an entering detector at the entering end of the retarder and a leaving detector at the leaving end of the retarder subject to actuation by said car upon approaching and leaving said retarder respectively for registering the presence of said car in a stretch of track between said detectors, means controlled by said detector means for controlling said retarder to a preselected braking position prior to the entry of said car into said retarder, radar speed measuring means having an antenna with a radiation pattern including at least the area of said retarder rendered effective when said detector means registers the presence of the car and which produces an output signal that is at each instant proportional to the velocity of said car throughout its progress through said retarder, first control means controlled at least in part by said output signal of said speed measuring means for only partially reducing the braking effect of said retarder on said car when the output signal of said speed measuring means is a selected amount greater than that corresponding to said predetermined release speed, and second control means also controlled at least in part by the output of said speed measuring means for substantially fully releasing the braking force exerted by said retarder on said car when the output signal of said speed measuring means reaches

a predetermined value corresponding to said predetermined desired release speed.

31. In a car retarder control system for the control of a multiple braking pressure car retarder in a stretch of railway track, detector means including an entering detector at the entering end of the retarder and a leaving detector at the leaving end of the retarder subject to actuation by a car upon approaching and leaving said retarder respectively for registering the presence of said car in the stretch of track between said detectors, radar speed responsive means controlled by said detector means and having an antenna providing a radiation pattern extending along the stretch of track through said retarder for producing a continuously variable signal which is proportional to the instantaneous velocity of said car as it passes through said retarder, a plurality of speed relays, control means for said relays for operating each said relay to a first condition prior to the entry of said car into said retarder, said control means being governed at least in part by said output signal of said speed measuring means for operating each of said relays from its said first condition to a different second condition for respectively different values of said signal, whereby each of said relays is in its said one condition when said car enters said retarder with a speed greater than that at which any one of said relays is to be operated to its second condition and said speed relays are thereafter successively operated to their said second condition respectively as the speed of said car is reduced by said car retarder, and car retarder control means governed at least in part by said speed relays for operating said car retarder to a preselected braking position when all said relays are in their said one condition and for progressively reducing its braking pressure as said speed relays are successively actuated.

32. In a car retarder control system for the control of a multiple braking pressure car retarder in a stretch of railway track, detector means including an entering detector at the entering end of the retarder and a leaving detector at the leaving end of the retarder subject to actuation by a car upon approaching and leaving said retarder respectively for registering the presence of said car in a stretch of track between said detectors, radar speed responsive means controlled by said detector means and having an antenna providing a radiation pattern extending along the stretch of track through said retarder for producing a signal when said car is passing through said retarder which is at each instant proportional to the speed of said car, a plurality of speed relays, control means for said speed relays responsive at least in part to said signal for energizing each of said speed relays when the speed of said car within the retarder is above a first value, said control means controlling said relays to be deenergized successively for respectively different values of said signal when the speed of said car is reduced by said retarder, car retarder control means for operating said car retarder selectively to different braking pressures in accordance with the particular speed relays that are in their picked-up positions, whereby reduction in the speed of a car in said car retarder causes a reduction in the braking pressure applied by said car retarder upon the dropping away of one of said speed relays without removing all of the braking pressure.

33. In a car retarder control system for the control of a multiple braking pressure car retarder in a stretch of railway track, detector means including an entering detector at the entering end of the retarder and a leaving detector at the leaving end of the retarder subject to actuation by a car upon approaching and leaving said retarder respectively for registering the presence of said car in a stretch of track between said detectors, radar speed responsive means controlled by said detector means and including an antenna having a radiation pattern that includes the area of the car retarder for producing a continuously variable signal which is proportional to instantaneous car velocity, a plurality of speed relays, control

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means governed at least in part by said signal for energizing said relays, each said relay being actuated from one condition to the other by a respectively different value of said signal, whereby all said relays are actuated to their one condition when said presence detector means registers the presence of the car within the limits of said entering and leaving detectors and the car is proceeding at a speed in excess of the maximum speed for which any of said relays is actuated, and said relays are successively actuated to a second condition as the speed of said car is reduced by said retarder, car retarder control means rendered effective when the presence of the car is registered by said detector means and governed by said speed relays for operating said retarder selectively to different braking pressures in accordance with the particular speed relays that are in said one condition.

34. In a car retarder control system for a railway classification yard having a car retarder disposed in a stretch of railway track, said car retarder being selectively operable to braking and non-braking positions,

(A) detector means including an entering detector at the entering end of the car retarder and a leaving detector at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder in a given direction for registering the presence of cars on the portion of said stretch of track between said detectors,

(B) radar speed responsive means having an antenna with a radiation pattern including at least the area of said stretch of track between said detectors conditioned in accordance with the speed of a car only provided that the presence of the car is registered by said detector means, and

(C) circuit means controlled by said radar speed responsive means for operating said retarder to said non-braking position when the speed of the car is reduced to a selected value.

35. In a car retarder control system for a railway classification yard having a car retarder disposed in a stretch

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of railway track, said car retarder being selectively operable to braking and non-braking positions,

(A) detector means including an entering detector at the entering end of the car retarder and a leaving detector at the leaving end of the car retarder subject to actuation by cars respectively approaching and leaving said car retarder for registering the presence of cars within the portion of said stretch of track between said entering detector and said leaving detector,

(B) high frequency speed responsive means having a transmitter with a radiation pattern including at least the area of said stretch of track between said detectors for continuously generating a signal indicative of the speed of the car when the car is within the radiation pattern, and

(C) car retarder control means controlled by said speed signal provided that said detector means registers the presence of a car, for operating said car retarder to said non-braking position when the speed of the car is reduced to a selected value.

36. The invention according to claim 35 wherein said car retarder is actuated to said braking position in response to the actuation of said leaving detector when the car leaves said portion of track.

37. The invention according to claim 35 wherein each of said entering and leaving detectors comprises a photocell which is controlled by a light beam projected across the stretch of track at a level wherein the light beam is intercepted by the car body and also its couplers.

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